



Aalborg Universitet

AALBORG UNIVERSITY
DENMARK

Between grassroots and treetops

community power and institutional dependence in the renewable energy sector in Denmark, Sweden and the Netherlands

Kooij, Henk-Jan; Oteman, Marieke I.; Veenman, Sietske ; Sperling, Karl; Magnusson, Dick; Palm , Jenny; Hvelplund, Frede Kloster

Published in:
Energy Research and Social Science

DOI (link to publication from Publisher):
[10.1016/j.erss.2017.09.019](https://doi.org/10.1016/j.erss.2017.09.019)

Creative Commons License
CC BY-NC-ND 4.0

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Kooij, H.-J., Oteman, M. I., Veenman, S., Sperling, K., Magnusson, D., Palm , J., & Hvelplund, F. K. (2018). Between grassroots and treetops: community power and institutional dependence in the renewable energy sector in Denmark, Sweden and the Netherlands. *Energy Research and Social Science*, 37, 52-64. <https://doi.org/10.1016/j.erss.2017.09.019>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.



Original research article

Between grassroots and treetops: Community power and institutional dependence in the renewable energy sector in Denmark, Sweden and the Netherlands



Henk-Jan Kooij^{a,*}, Marieke Oteman^a, Sietske Veenman^a, Karl Sperling^b, Dick Magnusson^c, Jenny Palm^{c,d}, Frede Hvelplund^b

^a Radboud University Nijmegen, Institute for Management Research, P.O. Box 9108, 6500 HK Nijmegen, The Netherlands

^b Aalborg University, Department of Development and Planning, Skibbrogade 5, 9000 Aalborg, Denmark

^c Linköping University, Department of Thematic Studies – Technology and Social Change, 58183 Linköping, Sweden

^d Lund University, The International Institute for Industrial Environmental Economics, P.O. Box 117, 221 00 Lund, Sweden

ARTICLE INFO

Keywords:

Grassroots initiatives
Renewable energy transition
Institutional change
Conditions of possibility

ABSTRACT

The speed and progress of transitions towards renewable energy systems varies greatly between European member states. Among others, these differences have been attributed to the emergence of grassroots initiatives (GIs) that develop radical ideas and sustainable practices. The goal of this paper is to understand the differences in the emergence of GIs for renewable energy in relation to the institutional characteristics of Denmark, the Netherlands and Sweden. We analyze the possibilities of GIs to emerge and act within three dimensions: the material-economic, the actor-institutional and discursive dimension. We conclude that conditional factors lie within the material-economic dimension in terms of the biophysical conditions, the structure of the economy, energy dependency and the energy market. Within the actor-institutional dimension, we conclude that the presence or absence of fossil fuel incumbents, such as regional utilities, strongly influence the possibilities of GIs. Within the discursive dimension, openness for alternative discourses proved to be enabling for GI-activities, as well as democratized knowledge production. In addition to these conditions of possibility, GIs can also act despite dominant institutions, albeit limited. Finally, GIs need a strong network with knowledge institutes, technology developers and political parties in order to achieve institutional change that enables GIs to flourish. Without institutional space, GIs remain subjected to the dominant power-relations, and cannot exert much influence upon the energy system.

1. Introduction

The internationally shared political aim to move towards a sustainable and carbon neutral society calls for transformations of socio-technical energy systems worldwide [1]. In the European Union, there are concerns about member states' deviation from renewable energy action plans, different speeds and forms of the energy transition, and a lack of long-term consistency of policies. The energy transition is also hindered by administrative and technical barriers to renewable energy (RE) growth, which are often difficult to remove [2]. Despite concerted attempts within the EU to manage the RE transition, change is thwarted by vested interests, institutional lock-in and existing path dependencies in the energy sector [3].

To enable more radical changes in the energy transition, observers have emphasized the potential of 'grassroots initiatives' for developing

radical new ideas and sustainable practices [4,5]. Grassroots initiatives (GIs) are open and dynamic bottom-up activities that seek to provoke changes that go beyond or against the orchestrated paths of transition, but are self-organized and transformational. GIs include local and regional initiatives, established by groups and communities that aim for more durable energy systems in their direct environment. This includes NGOs and community organizations, but also collaborations with local authorities and businesses that are thinking and working 'out of the box' [6].

Although the potential of GIs has been acknowledged [7] attention from science and policy makers towards GIs has been fairly instrumental, selective and inconsistent. Academic attention towards the role of GIs has been dominated by case study approaches [8–13]. These studies focus mostly upon the individual characteristics of GIs, their performance and their role, how the performance of GIs could be

* Corresponding author.

E-mail addresses: h.kooij@fm.ru.nl, hjkooij@gmail.com (H.-J. Kooij).

improved by strategic niche management (SNM) [14,15] or by intermediaries [11,16]. However, comprehensive overviews of the development of GIs at the national or international level are scarce [17,18] [cf. 17,18] and much of the actual potential of GIs remains untapped [4,6,19].

To understand the current position and potential of GIs, it is crucial to study the origins and developments of GIs, the existence and appearance of GIs and their possibility to influence or adapt to their institutional environment. Therefore, we take an institutional approach to GIs, focusing on the effects of rules [18], resistance or support at the regime level [20,21] and strategies of GIs [12]. The central question of this paper is: *what are the conditions of possibility that enable GIs to flourish, and how do GIs in turn exert influence upon these conditions?* These conditions are categorized into material-economic conditions, actor-institutional conditions and discursive conditions.

To answer the research question, this paper explores the institutional setting of GIs across European countries, specifically Denmark, the Netherlands and Sweden, which are chosen because the three countries have very different development paths of GIs. In Denmark, GIs have been relatively successful [22–24], but recent developments have created a less supportive environment [25]. In the Netherlands, GIs were relatively uncommon until the late 2000s, but the establishment of GIs has accelerated since 2010 despite seemingly unfavorable institutional circumstances [18]. Third, Sweden provides an environment where (local) welfare state institutions are very active in renewable energy, taking up tasks that would be the domain of GIs in other countries and hence reducing the number of GIs.

This paper offers a comparative analysis of the three countries, based on a longitudinal reconstruction and analysis of the development, conditions of possibility and influence of GIs in each country. We build upon the seminal work of Jamison et al., who compared the rise of environmental GIs in Denmark, the Netherlands and Sweden and extend their work towards renewable energy and contemporary times [26].

The next section outlines our theoretical approach and offers a more elaborate sketch of the used methodology. In section three, each case is presented. Section four consists of an elaborate comparison between the countries and section five discusses the main conclusions briefly as the main points have been elaborated in section four.

2. A co-evolutionary institutional perspective

Following other co-evolutionary approaches [27,28], our perspective recognizes the evolution of systems and the effect their evolutions have upon other co-evolving systems. Because this paper deals with the understanding of the role of GIs within a regulated energy system, we introduce and distinguish three dimensions, based on the impact these dimensions have on GIs [see also 18,29]. The material-economic dimension, the actor-institutional dimension and the discursive dimension constantly evolve and influence each other. For example, institutions are being shaped in co-evolution with actors, and institutions simultaneously shape actors [12,28,30–32]. This study takes a co-evolutionary institutional perspective, in which institutions are defined as the ‘rules of the game’ [33] including formal and informal rules, which coordinate governance and in turn can be altered through interaction [34]. Whether or not actors can participate and have access to decision-making or to material-economic resources is defined by institutions, e.g. access to energy markets or institutions of political decision making [35].

Institutional structures are consolidated forms of interaction of networking activities, or social conditions to which agents seek to take strategic action. Through these actions, institutional structures are being created, enforced or altered, transforming the existing institutional setting. Such a co-evolutionary understanding enables us to analyze the changes and interactions of material-economic configurations with actor-institution configurations, in relation to an

understanding of power relations and the use of knowledge [31,36]. The institutional structure offers ‘conditions of possibility’: while it does not cause the emergence of GIs, it may provide institutional characteristics that enable GIs to develop activities or influence the institutional structure.

The paper focuses on the actor-institution configuration related to the emergence of the network of GIs in the field of renewable energy. Focusing on the mutual influence between GIs and their institutional environment requires an analysis of change processes in the institutional structure. To operationalize these ‘conditions of possibility’ we introduce three concepts as heuristic tools to create three levels of analysis, described in the next three sections.

2.1. The material-economic dimension

The material-economic dimension includes the biophysical conditions that enable energy production, transport and use, such as the presence of fossil fuels, the potential for renewable energy production and the geographical challenges for energy infrastructure. The availability of these resources creates (international) patterns of trade and dependency, and we therefore look at the energy mix as well as import and export patterns and the structure of the consumer market, including common practices for heat and electricity provision (e.g. history of district heating, central or decentral grid). This also includes grid infrastructure, ownership and access. The material-economic dimension also encompasses the demands for energy and resource dependency, such as e.g. energy intensive industries. The biophysical and economic circumstances provide conditions that allow or prevent GIs from acting in the energy system.

2.2. The actor-institutional dimension

This dimension focuses on the dynamic relationship between institutions, actors, and (formal) regulations, in order to gain more insight in the relations between GIs and other actors and the ‘rules of the game’. It includes actors involved in energy, including energy policy and ownership of energy production, storage and infrastructure facilities. Maintaining a multi-level perspective of governance, we include relevant actors, platforms, networks, formal and informal institutions from the national and sub-national levels. Moreover, we look at the rules which shape the interactions between these actors, including possibilities and voids for GIs that may differ among countries and regions. These rules include historical governance traditions, the access of GIs to policy making and implementation processes, openness to change, and more formal regulative aspects [12,32,37].

2.3. The discursive dimension

The discursive dimension acknowledges the importance of discourse in the institutional structure. This dimension analyzes how GIs are embedded in the (dominant) discourses that are present in the institutional structure, relating to both the content of discourses and power relations. This provides insight in the mobilization of GIs and how they align with dominant discourses, resist or alter them. The content of discourses refers to dominant ways of thinking, ideas and ideologies about renewable energy and the position and legitimacy of GIs. These discourses can be contradictory or complementary and provide a certain degree of legitimacy for community action and for the energy transition in general, and may align or conflict with the motivations and ideas of GIs themselves. The discursive dimension is clearly linked to the actor-institutional dimension through a notion of power. This discursive power, or the dominance of certain ideas about ‘how things are done’, is visible in political, social and economic interactions and influences the hierarchies and (mutual) dependencies between actors and their access to formal power and resources.

2.4. Methodology

Based on the broad definitions of each dimension that were provided above, the three dimensions are sketched for each country for the period between the 1960s and 2010s. The conditions of possibility within each dimension were then identified inductively through a comparison between the countries. For each case, the focus is on the development of the movement of GIs and their interaction between them and the institutional configuration in which they develop, identified through the three dimensions. The focus is on recent developments and the current situation, but historical background is included where it is relevant for an understanding of the current institutional configuration and position of GIs.

The analysis is based on three types of data. First, a content analysis on the emergence and presence of GIs was conducted based on policy documents, research reports and available data on GIs in each country. This was supplemented by an analysis on the energy transition in each country, based on a literature review. For both steps, relevant references are included in the analysis. As a third step, we conducted a series of interviews with key actors in the GIs movement and/or the energy transition, in order to validate our findings. These interviews were semi-structured and often informal, and in some cases entail more regular contact between the researchers and respondents. A list of key respondents is included in [Appendix A](#). As the Danish energy transition is the most well-researched, this case is mostly based on the literature review, whereas the Dutch and Swedish cases use more interview data.

3. The development of grassroots initiatives in Denmark, the Netherlands and Sweden

Because of different biophysical conditions, economic developments and political responses to the economic crises in the 1970s and other institutional shocks, Denmark, the Netherlands and Sweden are three very different energy systems. Prior to the 1970s oil crises, Denmark and the Netherlands depended completely on fossil fuels: Denmark imported foreign oil and gas while the Netherlands benefited from large gas reserves. Meanwhile, Sweden knew a growing number of commercial hydropower plants: the majority of the over 2000 hydropower plants that are currently in operation were established between 1940 and 1980, out of which 200 have a capacity of 10 MW and higher, with technologies that were largely domestically developed and benefiting from the favorable biophysical conditions.

The oil crises in the 1970s led to severe concerns about security of energy supply, and countries looked at alternative sources for energy. The Netherlands and Sweden explored nuclear opportunities, leading to the establishment of two nuclear power plants in the Netherlands and five in Sweden, despite fierce public opposition in both cases. In 1980, Swedish people voted in an advisory referendum for a nuclear phase-out, but this remains a debated issue. Consequently, three remain in operation and the aim to phase out nuclear power by 2010 was abandoned in 2009. The Netherlands had a pro-nuclear political ambition until the Chernobyl disaster in 1986. Currently, one nuclear power plant remains. Denmark did not pursue nuclear power, turning to renewable energy instead.

The current energy mix of each country reflects these historical developments (see [Table 1](#), based on data of [\[38\]](#)). In Denmark, electricity is produced mostly with wind power and (imported) coal, and heat is produced using biofuels and waste. Sweden also uses biofuels and waste to generate heat, but produces electricity through a mix of hydropower and nuclear power. Of the three countries, the Netherlands is the most fossil fuel oriented, relying on imported coal but mostly on natural gas, which is cheaply domestic available and generates revenue for the Dutch state.

The next sections illustrate how in these three systems with very diverging policy orientations and energy sectors, grassroots initiatives for RE made an entrance. We describe the co-evolutions of the material-

economic, actor-institutional and discursive environment that the energy system provided and how GIs fit into this environment.

3.1. Denmark

The self-sufficiency percentage in total energy production is continuously decreasing and is down to 89% in 2015, including oil, natural gas and renewable energy production [\[39\]](#). As prognoses indicate a substantial decline in domestic oil and natural gas self-sufficiency within the next 20 years [\[40\]](#), this development urges Denmark to continue the shift to other energy sources within the next decades. As such, the share of renewable energy (mainly wind power) in the total domestic electricity supply increased from close to 0% in 1985–42% in 2014. The share of renewable energy of the gross energy consumption increased from 2.7% in 1980–26% in 2014. In the heating sector, district heating now covers roughly 50% of total heat demand, and is based 50% on renewable energy sources – mainly biomass [\[41\]](#). In total, green energy technologies now constitute almost 7% of total Danish export in 2016, or around 5.7 billion Euros. In 2017, a total of 4910 wind turbines with an installed capacity of 5229 MW exist in Denmark. Out of these, 20% (1082 MW) are estimated to be locally-owned by citizen cooperatives (549 MW), farmers and local landowners (484 MW) (based on [\[42\]](#)). Support schemes were developed and continuously adapted for wind power in general, supporting local ownership in particular.

Already in the 1920s several small community-owned cogenerating plants started to use waste heat for heating purposes in their surroundings. A district heating association was established in 1957, and mainly included municipality owned district heating companies in the larger cities. From 1992–2005 these and new district heating systems were upgraded to cogenerating plants based on natural gas and biomass. In 2016, roughly 64% of all households are connected to district heating, which is being produced in 430 heat and CHP plants, and distributed by 407 DH distribution companies. 341 of the distribution companies are either consumer-owned and 47 are municipality-owned [\[43\]](#).

3.1.1. After the oil crises

As a consequence of the 1973 oil crisis and the interest of the parliament and the large power companies to introduce nuclear power, a lot of grassroots initiatives were started that introduced the idea of renewable energy to challenge the dominant energy discourse. These new initiatives and discourses overlapped with the critical situation Danish society was in due to the oil crisis and led to an openness to find solutions “that could work”. In the 1980s, Denmark had a 2–4% of GDP balance of payment deficit, a 7–10% unemployment rate and 4–10% inflation [\[44\]](#). The hegemonic discourse was focused upon self-sufficiency and focused on nuclear energy (later on coal) on the one hand, and to a minor extent on energy efficiency, renewable energy and natural gas on the other.

Many informal network activities in working groups, folk high schools, and environmental NGOs (NOAH – Friends of the Earth) helped form the knowledge base for the later, more energy-specific GIs. As such, new and independent actors were able to explore and articulate new discourses across ever more segments of Danish society. Local energy offices were established in many municipalities around 1975, often with the involvement of people from existing networks. The informal networks of environmental and local activists developed into a set of influential, national GIs, through the establishment of the Organization for Information about Nuclear Power (OOA) in 1973; the Organization for Renewable Energy (OVE) in 1975 and the Federation of Energy Offices (SEK) in 1977 [\[45–47\]](#). OOA collaborated with Danish universities on the elaboration of the first alternative Danish energy plan which was published in 1976, see also below [\[48,49\]](#).

Specific actors and energy activists had a strong influence on the development of renewable energy, being linked at different levels and

Table 1
comparison of energy production and use. Data from the International Energy Agency [38].

	Denmark (2014)		The Netherlands (2014)		Sweden (2014)	
Total primary energy supply (TPES)	16.21 Mtoe		72.95 Mtoe		48.16 Mtoe	
TPES per cap	2.87 toe/capita		4.33 toe/capita		4.97 toe/capita	
Net imports	2.20 Mtoe		30.51 Mtoe		16.30 Mtoe	
production electricity	Total 32183 GWh	100%	Total 103418 GWh	100%	Total 153662 GWh	100%
	Coal 11064 GWh	34.4%	Coal 32420 GWh	31.3%	Coal 994 GWh	0.6%
	Oil 317 GWh	1.0%	Oil 1906 GWh	1.8%	Oil 300 GWh	0.2%
	Gas 2096 GWh	6.5%	Gas 51522 GWh	49.8%	Gas 413 GWh	0.3%
	Biofuels 3407 GWh	10.6%	Biofuels 3105 GWh	3.0%	Biofuels 9070 GWh	5.9%
	Waste 1609 GWh	5.0%	Waste 3535 GWh	3.4%	Waste 2855 GWh	1.9%
	Nuclear –	0%	Nuclear 4091 GWh	4.0%	Nuclear 64877 GWh	42.2%
	Hydro 15 GWh	< 0.1%	Hydro 112 GWh	0.1%	Hydro 63872 GWh	41.6%
	Solar PV 596 GWh	1.8%	Solar PV 785 GWh	0.8%	Solar PV 47 GWh	< 0.1%
	Wind 13079 GWh	40.6%	Wind 5797 GWh	5.6%	Wind 11234 GWh	7.3%
production heat	Total 122136 TJ	100%	Total 147157 TJ	100%	Total 179896 TJ	100%
	Coal 24648 TJ	20.2%	Coal 3362 TJ	2.3%	Coal 13979 TJ	7.8%
	Oil 1154 TJ	0.9%	Oil 21375 TJ	14.5%	Oil 3016 TJ	1.7%
	Gas 23469 TJ	19.2%	Gas 103274 TJ	70.2%	Gas 5225 TJ	2.9%
	Biofuels 43815 TJ	35.9%	Biofuels 1096 TJ	0.7%	Biofuels 97888 TJ	54.4%
	Waste 25323 TJ	20.7%	Waste 18050 TJ	12.3%	Waste 40783 TJ	22.7%
	Geothermal 83 TJ	< 0.1%			Other 19005 TJ	10.6%
	Sol. thermal 662 TJ	0.5%				
	Other 2982 TJ	2.4%				

in organizations across networks. Such persons played a crucial bridging role, because they were able to bring together different agendas and improve the flow of knowledge in the growing renewable energy scene. Apart from that, there were strong links between GIs and the green majority in Parliament, especially between 1980 and 2001. Danish governments often rely on a very small majority and also in many cases are minority governments. This means that relative small numbers of people can be crucial to the power balance in the parliament. This played a role when the wind power industry was struggling in 1986/1987: due to the political force of 100.000–150.000 owners of wind power shares, companies, such as Vestas, could be reestablished after bankruptcy [50]. The Danish Wind Turbine Owners' Association, which was established 1978, played an important role as a strong lobby organization in this regard.

Discursively, during the discussion between nuclear and renewable energy, the GIs showed that renewable energy provided a realistic pathway for the Danish energy system. In an atmosphere of openness in the political arena, (critical) inputs from a wide spectrum of (independent) actors were welcomed. The proponents of renewable energy (OVE, OOA) had a strong principle of “getting the facts right” and provided realistic, well documented alternatives to the official energy plans. These organizations thus realized the need for positive and constructive communication around energy issues, which focused on developing concrete alternative solutions to nuclear power, instead of limiting themselves to protesting against the very same.

The concrete outcome of this knowledge exchange between the central administrative levels and society were new institutions in the form of a series of *official energy plans* (1976 and 1981) and *alternative energy plans* (1976 and 1983), with the methodology and structure of the second alternative plan even giving inspiration to later official energy plans [51]. The first one of these plans showed that it was possible to include alternative energy sources, as it did not include nuclear energy and the use of more coal. Renewable energy sources plus energy conservation measures could replace nuclear power plants without increasing the use of fossil fuels [48,49]. This knowledge exchange between official and GI-initiated alternative energy plans led to considering renewable energy as a realistic alternative to nuclear energy, supported by e.g. concrete production data. The institution of official and alternative energy plans supplementing each other continues till

this day.

Besides the (in)formal GI networks including places of higher education, an important aspect of the level of actors/institutions is the pre-existing technical and ownership infrastructure, and the small-scale entrepreneurial infrastructure. These were, and partly still are, the typical Danish consumer- and municipality-owned electricity supply and district heating companies. The co-operative ownership structure in combination with an industrial structure characterized by many small, innovative companies and craftsmen, was the backbone of the development of new technologies at the energy scene. Furthermore, the development had deep historical roots with prototypes of electricity producing wind turbines already being developed and tested around 1900 (by Poul La Cour at Askov Folk high school) [52,53].

In terms of discourses, creating authoritative knowledge that stated that RE was true and reliable was essential for the credibility of the RE discourse. The Danish “culture of experimentation” has led to many different test cases that eventually played an important role as a show case telling that wind power was a realistic possibility. In order for wind turbines and other renewable energy technologies to live up to quality requirements, an official certification scheme was needed, and for this purpose, the National Wind Turbine Test Center was established in 1978 at Risø (DTU) [54]. The Risø National Laboratory strongly encouraged small companies to act “professionally” in this regard; i.e. to develop reliable technology demonstrating to decision makers that the industry was developing in a serious way with a view to international markets, too [55]. In May 1975, volunteers at the teacher training college started to build the 2 MW Tvind wind turbine in collaboration with experts from amongst others the DTU. The wind turbine was ready for production in 1978, and has produced power since then although only at a capacity of around 1 MW.

Institutionally, from 1986 to 2000, specific institutional requirements supported local ownership of wind power. For instance, an owner of a wind turbine share was required to have permanent residence in the municipality where the wind turbine was located¹ [56]. Also, the number of wind turbine shares that individuals could own was limited. The result of this was that the share of co-operative ownership was

¹ Until 2007, there were 271 relatively small municipalities in Denmark.

increased very much to an estimated 100.000 privately owned shares in 1990 [57]. Even though the former ownership requirements were abolished in 2000 [58], since 2008, according to the Renewable Energy Act, wind power project developers have to offer at least 20% of a project's share for sale to local citizens [59].

3.1.2. After the liberalization

No central power plant has been built during the last 20 years. The fossil-fuel based power plants were non-profit (“consumer-profit”) companies until 2004 and could survive market losses as they per law had the right to cover their costs by increasing power prices. This consumer ownership/consumer-profit organization resulted in a less persistent fight against wind power from the power companies, as they were not fighting “for their life”. However, the large increase of the wind power share in domestic electricity consumption during the last 20 years contributed to substantial market losses for large, incumbent energy companies. Concurrently, when the Danish power producing companies in 2004 were changed from non-profit (and safe income) to for-profit companies, they did not gain any profit due to the large wind power share in the electricity mix. Consequently, at present, the established power companies have a strong motivation to lobby against local co-operative ownership of more wind power. District heating on the other hand, has maintained its legal and economic status as a “natural monopoly”, making it possible for the central administration to govern district heating companies with non-profit/consumer-profit rules. In this way, consumers are protected through including the requirement to pay any profit accumulated in DH companies back to the heat consumers [60].

The positive discourse for the growth of GIs was challenged from 2002 onwards, when a new right wing government started with a very clear policy against green energy technologies. As a result of the removed funding for renewable energy, nearly no new wind turbines were installed between 2003 and 2007 after the rules of the new government applied. Although the policy from 2002 to 2007 was destructive for renewable energy development, it appeared to be impossible to stop the momentum of GIs and renewable energy due to the institutionalization of GIs in the Danish society. By now, 100% renewable energy in 2050 has developed into a mainstream discourse across political parties, industry and society.

3.2. The Netherlands

In the Netherlands, fossil fuels still make up over 90% of the Dutch energy supply [61] and the share of RE was 5.6% in 2015. The energy system underwent significant changes in the past decades including the liberalization of the energy market and subsequent unbundling of electricity production and distribution, which is still ongoing. The share of production facilities owned by GIs is negligible, amounting to around 200 MW for wind turbines and 3500 kWp for solar projects [62]. Since the discovery of large gas reserves in Slochteren in 1959, the Netherlands has been a net exporter of natural gas, exporting over 60% of its production. This came to a halt in 2015, when gas mining was cut drastically after a series of local earthquakes and following public protests [63]. Following the discovery of the Slochteren gas reserves, gas fired power plants took a leap, accounting for around 80% of the electricity sector in the mid-1970s [64]. Currently roughly 50% of electricity is produced using natural gas, which is also the main source for heating and cooking. The gas revenues are a major source of income for the Dutch state, they were around 7 billion euros in 2015 [65].

The dominant actor-institution configuration in the Dutch energy system was created after the discovery of natural gas. The 1960s marked the rapid transition to natural gas and subsequently a growing power position for the Dutch gas mining company NAM, which holds the monopoly to gas mining. Energy was seen as an economic commodity and low energy prices drew foreign energy intensive companies to the Netherlands, so the chemical and metal industries flourished. The

Dutch national government had little interference in the energy system: electricity provision was dominated by large regional companies (with province and municipalities often as shareholders) and the gas sector was largely independent, although the government supported the establishment of a national gas grid. The central government tried to gain foothold through the introduction of nuclear power and invested in technological developments of nuclear power applications.

3.2.1. After the oil crises

The Dutch energy discourse changed after the oil crises. The oil crises had revealed a strong dependence on foreign imports of fossil fuels, causing the government to aspire a firmer grip on the energy system. Meanwhile, a public debate emerged on the undesirability of nuclear power and environmental concerns. The previously stable dominant discourse of economic growth and technological opportunities was challenged from many sides, including feminism, anarchism and radical environmentalism. A debate emerged on energy savings, green alternatives and the declining belief in economic growth. Simultaneously, the anti-nuclear movement started protesting against nuclear power for energy production, and a social debate emerged on nuclear waste, safety and radiation. The public discourse on energy had shifted quite suddenly and disruptively, forcing policy makers to react. Despite public opposition, the Dutch government aimed to reduce its international energy dependence through an increase of nuclear power. Energy savings already made an entrance into Dutch policy documents from 1974 onwards (First White Paper on Energy), not out of environmental concerns but as a means to reduce the international independence on an unstable market. In the 1970s, energy policy became coupled with environment and spatial planning, and nuclear power became the main strategy to diversify the energy mix [66,67]. The 1980 Second White Paper predicted a limited potential for renewable energy in the Dutch energy mix. Renewable energy was seen as a means to reduce the consumption of fossil fuels but not to replace them.

In terms of actors, new citizen initiatives emerged as the national energy system remained unchanged, because the government focused on plans and debates in the 1970s and. A number of *bottom up* working groups and initiatives started on environmental and sustainability issues, such as ODE (*Organization for Renewable Energy*). ODE started in 1979 as a network for citizens who built their own wind turbines, and grew to become the umbrella organization for GIs for renewable energy.

The first RE producing GIs emerged in the late 1980s when some of ODE's members realized that private ownership of turbines was more feasible if organized through a cooperative or legal association. Cooperative ownership was inspired by the ideas of the anti-nuclear movement and enabled by the 1989 Electricity Act that gave these GIs grid access and guaranteed a standard price [68]. In 1987 the first cooperative turbine was erected in Delft. The number of cooperatives grew to 25 in the early 1990s, and these GIs exploited (and often still exploit) a small number of local wind turbines and acted on a discourse that combined environmental concerns with a wish for local independence. The GIs themselves had fulfilled their own ambitions and did not intend to grow or expand their activities. The focus in the actor constellation was on the government and large market players such as the fossil fuel industry and energy intensive industry.

After the establishment of the first wind turbine cooperatives in the late 1980s and early 1990s, some years followed in which the only noticeable change in community RE took place in Friesland. In this Northern Dutch province a small number of wind cooperatives emerged with an entirely different goal in mind. Friesland hosts nine small villages that each own their own single wind turbine, exploited through a village cooperative or association. These turbines, erected in 1993–1998, are built by local village interest groups, not out of environmental concerns but with the sole purpose of generating profits for the local community.

Discursively, following the first IPCC report in 1990 and – later- Al

Gore's "an inconvenient truth", energy was coupled with climate change in the early 1990s, and thus energy problems were framed as issues of environmental sustainability. Innovation and integration were main concepts in policy development, as reflected in e.g. the 1996 EET-program (Economy, Ecology and Technology) that was based on the premise that technological innovation should be placed in a context of social and institutional changes [69].

3.2.2. After the liberalization

The late 1990s and early 2000s are characterized by large institutional shifts, mostly regarding the European Union induced liberalization of the energy market, which came into effect for large companies from 1998 onwards and for the consumer market in 2004. The process leading up to liberalization was messy and 'led to a ... large insecurity about the future for all involved parties' [70].

Institutionally, the complete liberalization of the energy market in 2004 increased the opportunities for initiatives, because energy suppliers profiled themselves as 'green' and consumers had more influence in the market. Led on by a few high-profile activists and media coverage of pilot projects and the need for sustainability and renewable energy, a third wave of RE projects took off. The new projects are distinctively different from the traditional wind cooperatives. Only a few have active collective facilities for RE production, although most aim to do so in the future. The initiatives are typically highly ambitious: 'collectively saving, producing and supplying green energy' seems to be the motto, and covers about every activity an initiative could possibly do regarding RE.

Discursively, the long-term perspective on innovation and moving towards sustainability developed into a jargon on "transition". This was a discourse in which GIs were actively supported, perceived as legitimate, and in which citizens were encouraged to take up the energy transition challenge, which is a large part of the explanation for the rapid expansion of GIs during this era. The GIs movement can be viewed as a reaction to scaling up, privatization and liberalization of the energy sector. The government has withdrawn itself from a sector that used to be publicly owned. Energy companies Nuon and Essent are even fully privatized and taken over by multinationals. Some co-operatives felt that this has gone too far, and search for a 'human measure' and more say in the way in which energy is produced: back to basics. Meanwhile, the liberalization creates opportunities for power for consumers. The small scale of RE technologies – mainly solar PV and small wind projects – brings RE production within the reach of GIs.

A remarkable discursive shift occurred in 2010 under the pressure of the economic crisis and under the liberal minority cabinet Rutte I. RE support was seen as expensive, overregulated, and ineffective, and an answer to (future) energy scarcity should be found in – surprisingly – nuclear power. Energy became framed in terms of energy security, competitiveness of RE and international trade. The two main stimuli for RE were the SDE+ (successor of the SDE, *Stimulation of Sustainable Energy Production*) and the Green Deals [71]. The SDE+ is introduced in 2011 and is no longer available for individuals, only for companies and organizations.

In terms of institutions, new energy policies were initiated by the 2013 Energy Agreement, signed by the national government, employers, business representatives and environmental groups. A very small part of the agreement was dedicated to community energy, specifically the 'zip code rose project', a case of distant net metering. Through this model, energy consumers receive an energy tax deduction for the amount of energy produced within a collective RE project, situated in their zip code area or an adjacent area [see 18]. The first two years after the zip code rose, legislation was unclear and it was not a feasible business model due to VAT obligations. After intensive lobbying of GIs and support groups, cabinet and parliament decided to increase the energy tax reduction from 7,5 eurocents per kWh to circa 10 eurocents per kWh. Despite the still modest profits, 38 zip code rose projects were realized in 2016 [18]. Overall, the strongly economic

discourse forms a constraint for GIs to acquire a position, but recent developments of the Energy Agreement [71] and Agendas [72] appear to create more legitimacy for the idea of collaborative action and active citizenship. However, GIs act from a discourse of energy transition and energy-independence, while the government firmly articulates the economic discourse. Consequently, GIs develop in the absence of clear governmental support [see 18].

3.3. Sweden

Sweden has a tradition of an industrialized economy. The rich occurrence of resources of forests and iron-ore, together with a mountainous north has been advantageous [73]. Sweden is often seen as a role model in building the "welfare state" in the post-war period, in the trail of strong economic development followed heavy exploitation of resources. The strong economy led to an, by international comparison, early development of nuclear power with heavy state involvement. In 1947, *AB Atomkraft* was developed and together with large private companies, the technology was developed. In 1963 the first reactor was started, focused on research but also on producing district heating, although it was outdated already in 1973, but the first commercial reactor was started in 1972 [73]. Together with hydropower, the presence of nuclear power meant cheap, non-fossil electricity production in Sweden during the next decades.

Parallel discourses existed from the 1950's until the 1970's. On the one hand, a "supply discourse" focused mainly upon the delivery of cheap energy to the point of consumption thanks to economy of scale and an understanding of energy resources as almost infinite [74] and on the other hand, discourses of conservation and environmental protection, following debates on the exploitation of the nature [26].

Until the 1970's prices had in general decreased for almost a decade [74] and pricing was mainly based on production costs until the liberalization of the electricity market in 1996. The high voltage market set their prices based on state owned Vattenfalls prices, and the low voltage market was limited to the law on reasonable pricing and municipal regulations on self-cost pricing [75].

In terms of actors and institutions, the structure of the Swedish society is important for understanding the development of GIs in Sweden. Especially important is the 'Swedish Model' [cf. 74], which came in place 1902 with the 'Electricity Act' and was maintained until the 1990s. This model refers to major power companies producing electricity and municipality owned companies that distribute the electricity [74,76]. In the mid-1930s the exploitation of the large hydropower resources in the North of Sweden started [77], but large amount of power transmission to the more densely populated southern part was necessary. In 1907 the Swedish government established *Kungliga Vattenfallsstyrelsen* (today Vattenfall AB). Vattenfall built regional high voltage cables together with other major power companies. The national transmission grid of high-voltage lines are today (and since after 1946) owned and managed by the state [78]. The energy market has significant inertia and low rates of innovation, due to the considerable capital cost of production and the durability of nuclear and hydro power.

3.3.1. After the oil crises

A new discourse of efficiency grew in the 1970s, following the oil crises and that environmental effects, such as acidification of lakes, forest deaths and first debates about CO₂-emissions became apparent in the 1980's. The nuclear power accidents in Harrisburg and later in Chernobyl put further pressure on change. A referendum over the future of nuclear power was held in 1980 and even though the procedure was complicated, as voters decided between three options, the decision afterwards was a full dismantling until 2010 [26,74]. The solution was to use nuclear in a transition period, focus on domestic renewable resources, and energy- and resource efficiency [74].

In terms of actors, the debate on nuclear power in the eighties led to

the establishment of the first GIs on renewable energy in Sweden, the eco-villages, as the initial pioneers had their roots in the anti-nuclear movement. They saw their role as inspirers to the municipalities to move toward more environmentally friendly and innovative systems, as well as aim for sustainable living [79,80].

During the 1990s and the 2000s, the discourse focused mainly on a transition to renewable resources, and especially biomass. Several national policies strengthened this, such as sulfur and CO₂-taxation in 1990 and 1991, subsidies for biomass combined heat and power, wind power, and solar heating in 1991. The debate further changed to an idea of ecological modernization, as it became obvious that the growth optimism from the 1950s and 1960s was not feasible when the ecological side effects were known. Instead, the ecological awareness was seen as a driving force and the technological development connected to it was rather an advantage as it led to progress and growth [81,82]. Climate change became the main issue, to a large extent around the time of the Kyoto agreement. Global concerns, such as sustainable development and the implementation of the Agenda 21 program in most municipalities, were implemented into the Swedish policy and shaped the discourse to a large extent [82,83].

3.3.2. After the liberalization

Institutionally, the change in discourses was reflected in the change of the 'Swedish Model', which was induced by the deregulation of the electricity market in January 1996, in tandem with the globally rising environmental awareness. The official aim of deregulation was to stimulate greater system efficiency and allow greater customer flexibility at the lowest possible price through increased competition among actors. The reform entailed the production and sale of electricity being separated from the transmission of electricity, thus enabling competitive production and trade. The district heating sector became commercialized at the same time, as heating was now to be sold on market pricing rather than self-cost price [84]. The ownership of energy companies changed significantly around the time of the liberalization. A concentration in ownership of electricity companies took place as industrial producers sold their electricity production to a few actors. The electricity market did also become international, as Finnish and German owners entered the market while Vattenfall expanded their market share outside of Sweden [77]. Municipalities decided to sell both electricity and district heating companies and today 51 percent have purely municipally owned district heating companies and 20 percent have private owners, compared to almost uniform municipal ownership prior to 1990 [84].

The new institutions created by the liberalization opened up opportunities for GIs. The first wind cooperative started 1990 in Näs at the island Gotland. The purpose with this and most wind cooperatives is to generate electricity to cost price to its members and/or be able to sell the surplus to the grid. The economic investment support for wind power helped the wind development in general and cooperatives followed this gained momentum [85]. The LIP (Local Investment Program) and KLIMP (Climate Investment Programme) programs were important measures and helped the development of local heating systems [86]. The green electricity certificate system, initiated in 2003, supported the development of RE production. For each produced MWh renewable electricity the producer gets 1 certificate that can be sold on an open market, thus generating more income. The buyers are electricity suppliers, which are obliged to buy the certificates [87]. Regulations and economic incentives have restricted the possibilities for small actors to enter the electricity market. The network operation was seen as a natural monopoly and the network is still regulated and supervised by the authorities [83,88].

The energy supply from renewable sources, such as wind and solar PVs, produced by prosumers started in 1997 and have increased since then [89]. This is related to the change in legislation which makes it feasible to sell the own-produced electricity back to the grid and due to state subsidies and tax-reduction for micro-producers [89]. Since 2009

it is possible to receive state aid for installation of PVs. The maximum level is 30% for companies and 20% for other actors. Since 2015, micro-producers of renewable electricity can also receive a tax reduction of 60 öre/kWh [90]. Today there is an increasing trend where more private households as well as housing companies or real estate owners take interest in installing PVs. But the market share for PVs is still small, not even 1% of total electricity production [91].

In terms of actors, GIs were limited due to monopolies before 1996, due to strong municipalities in both electricity and heating sector and low energy prices. Incentives were also low, as the energy production was relatively clean and municipalities took responsibility in energy transition. Most economic means of control have focused on the large producers or industries, the municipalities or individual households, leaving little opportunities for obvious support for GIs. It can also be noted that municipality owned cooperatives do now exist, and it shows how municipalities are moving into this new niche. Municipal energy companies, such as Jönköping Energi and Kalmar Energi (owned 50% by E.ON) have started wind cooperatives and the latter is starting a solar PV cooperative [80].

As shown, the power relations were for a long time set in stone in Sweden, dominated by large players. It is possible to identify some pioneer GIs, already as early as the eighties, that wanted to give the power back to the people and reduce the power for globalized companies. A bigger reason for people in Sweden to become prosumers has been to resist a central electricity system governed by a few multi-national companies [89] and directly linked to the actor-institutional dimension.

Currently, the Swedish GI community is not as prominent as in Denmark and the Netherlands. Nevertheless, today there are 81 wind cooperatives that make up around 10 percent of the total produced wind electricity, 6 active solar PV cooperatives, and 4 more in formation, producing less than 1,5 MW in total, 10 small scale district heating producers, 25 eco-villages (focusing on energy savings, biomass heating or solar PV/heating) and 9 rural communities owning hydro, wind or heating system, all with an overarching aim of energy savings [80]. In 2012, 25,000 households owned shares in wind power cooperatives [85].

4. Comparative analysis: conditions of possibility for grassroots initiatives

The country studies demonstrate that grassroots initiatives in Europe emerge differently and in very different institutional settings across Europe, and that characteristics of this institutional environment may affect their possibilities to emerge and become successful. A comparison between the three countries enables the identification of 'conditions of possibility' for each dimension, demonstrating not only the influence of a certain aspect of the institutional structure but also the way in which this can be a constraint or enabling factor: e.g. energy prices may be left to market mechanisms, which is a constraint for grassroots initiatives, or feed-in tariffs or other subsidies may be installed, which could be an enabling factor. This section provides an overview of the conditions of possibility that were identified through a comparative analysis of the three countries in each dimension.

4.1. The material-economic dimension

The material-economic dimension displays economic mechanisms and path dependencies that influence the opportunities for GIs. We have identified five main 'conditions of possibility', which will be elaborated on below (see Table 2).

The structure of the economy strongly influences the emergence of GIs. Sweden and the Netherlands are historically more industrialized than Denmark, which has a more decentral oriented economy [92–94]. An industrialized economy with heavy industry requires a centralized and reliable energy production and a centralized energy infrastructure.

Table 2
Conditions of possibility for GIs in the material-economic dimension.

	Constraining conditions for GIs	Enabling conditions for GIs
Structure of economy	Industrialized economy with centralized energy production and tax exemptions for energy intensive industry	SME economy, decentrally organized energy infrastructure and provision
Energy dependency	Availability of cheap domestic (fossil) central energy sources, fossil fuels state revenues	High dependence on (fossil) fuel imports: international dependency
Renewable energy potential	Low (small-scale) RE potential due to biophysical conditions	High RE potential due to biophysical conditions
Costs of renewable energy	High (installation) costs of RE compared to conventional energy	Low (installation) costs of RE compared to conventional energy
Energy prices	Energy prices set by market mechanisms, no correction for externalities. Or: competitive RE prices enabling market parties to engage in RE	Feed-in tariffs, subsidies on RE, CO ₂ taxation

As a consequence of the relative importance of the energy intensive industries in the Netherlands and Sweden, such as the steel, mining and petrochemical industry, these industries have obtained tax exemptions in order to remain globally competitive. Centralized energy production and distribution are less suitable for renewable energy production (with the exception of large scale hydro-power as seen in Sweden) because wind and solar power typically emerge decentralized and did not match very well with the often continuous energy demand of large industries. Denmark has a more small-scale entrepreneurial oriented economy and decentralized energy system, which is better attuned to renewable energy in general, but in particular to grassroots initiatives which are decentral in nature and benefit from the absence of large interests and lobby for artificially low energy prices for the energy intensive industry.

All three countries have path dependencies in their energy landscape, in part based on the biophysical conditions within each country. The Netherlands depends heavily on domestic gas and imported coal and oil; Sweden on domestic hydropower, nuclear power and district heating, and Denmark on oil [95]. Once an energy infrastructure has been established, the large investments ensure that it remains dominant for decades, a mechanism that is described as ‘carbon lock-in’ [96]. This holds true for all centralized energy production systems with long-term investments in production facilities and infrastructure. However, shocks to the system such as the oil crises have the capacity to break these dependencies. The reaction of each country depended on their economic structure and the availability of domestic (fossil) alternatives to imported oil. Other shock events, such as the Harrisburg nuclear accident in 1979 and the 1986 Chernobyl nuclear disaster, also impacted the energy landscape. Again, the extent of the domestic impact depended on the structure of the economy and the biophysical availability of alternative resources.

The production of renewable energy also largely depends upon the biophysical conditions of a country. Mountainous regions such as in Sweden are suitable for generating hydropower [97] and coastal regions, found in all three countries, are suitable for wind energy [98]. Areas with high solar irradiation, found in Denmark and the Netherlands, favor solar PV [99]. Out of these resources, hydropower is the most economically interesting option, posing an advantage for mountainous areas. The high investment costs for hydropower and offshore wind power constrain GIs, who have turned to solar and onshore wind power solutions as they are more affordable for small scale projects.

Related to the biophysical limitations for RE are the costs for RE technologies. Recent decreasing implementation costs for RE technologies relative to the cost of fossil fuel energy has led to the adoption of new technologies for e.g. wind and solar PV in all three countries. However, development costs for RE projects are a crucial step prior to implementation, and with incumbent regimes favoring fossil fuel or nuclear solutions, research and development costs have formed a hindrance for the development of RE technologies. This was the case in the Netherlands and Denmark in the 1970s when limited RE development funding constrained the development of the wind sector. The network between GIs and the political arena allowed for experiments in Denmark, but the Dutch monopoly of energy companies prohibited RE

development in the Netherlands. Thus, an enabling factor for GIs is access to low-interest financing of R & D and of RE projects, and low installation costs compared to conventional energy.

The competitiveness of RE also depends on the mechanisms behind energy pricing in a country. When RE is much more expensive than fossil fuel energy, e.g. when pricing is left to the market and there is no correction for externalities, a business case for RE becomes impossible for GIs. This can be solved through subsidies, feed-in tariffs or emission taxations to account for negative external environmental effects. Conversely, when renewable energy is completely competitive, it will be adopted into the (large-scale) central energy production structure and there is no space or incentive for GIs, and no option to enter the energy market. This is the case in Sweden: the affordability of hydro-power combined with the large investments required created a clean, market oriented and centralized energy provision system in which nuclear power is supplemented by hydropower.

4.2. The actor-institutional dimension

An analysis of the actor-institutional dimension yields a variety of influential conditions of opportunity for GIs, which are listed and discussed below (see Table 3).

An analysis of the actor-institutional dimension demonstrates that existing market and policy structures have a large influence on the opportunities for GIs. The market orientation of countries determines the orientation of market players and the government's industrial policy. A focus on international competitiveness creates pressure to establish competitive energy prices in order to have the national industry compete internationally. The Netherlands and Denmark demonstrate this industry focus since the 1980s [100]. Sweden maintained a stronger welfare state in comparison, with a financial policy that impacted GIs less and was neither stimulating nor hindering.

The design of market rules and resources proved to be crucial for the possibility for GIs to engage in RE production. Historically, these rules and resources have been reserved for incumbents in a monopoly position in centralized and vertically integrated energy production systems. The liberalization of the energy market changed the rules and resource division drastically, but in different ways between the countries. In the Netherlands and Sweden, more space for GIs was created through more favorable entry rules and (more) level playing field. By contrast, in Denmark the low spot prices on the common electricity market after liberalization formed a barrier for GIs. Consequently, the liberalization of the energy market enabled GIs in the Netherlands and Sweden by ending monopolies and granting access, whereas in Denmark it terminated the relatively sheltered position in which GIs had developed previously.

Local ownership aids local acceptance of e.g. onshore wind projects, and conversely local resistance increases with the reduction of local ownership [50]. From their very nature, GIs are locally developed and owned projects, thus usually having a relatively high acceptance. Rules to support local ownership or ensure that the projects stay local and small-scale can therefore favor GIs [cf. 101,102]. These rules have been

Table 3
Conditions of possibility for GIs in the actor-institutional dimension.

	Constraining conditions for GIs	Enabling conditions for GIs
Market orientation	International market competition and lobby aimed at international competitiveness (industry policy)	National market orientation
Market rules and resources	Closed energy market; rules and resources tailored to large installations and players	Liberalization of energy market, increased domestic competition
Local ownership rules	No rules for supporting/protecting local and consumer ownership, or very restrictive rules	Rules supporting/protecting local and consumer ownership
Grid access and remuneration rules	Monopolized grid, no/uneconomic grid access, no guaranteed minimum prices	Affordable grid access or cooperating energy companies, guaranteed prices
Energy companies	Large energy companies that dominate energy production and distribution	Small energy companies (including consumer owned), ‘Green’ signature energy companies
Ownership energy companies	State owned energy companies	Consumer-owned energy companies
Business sector	Business sector aggressively developing RE projects	Competition and unbundling Minor share of businesses engaged in RE technology development early on
Political culture and decision making	Closed political culture, no access to (influence) decision making	Strong networks between GIs, knowledge production and sharing, policy and political influence and support

to varying degrees in place in Denmark, for instance, with limits on the number of shares per shareholder in a project; ‘residence rules’ by which wind turbine shareholders were required to live in the same municipality; and the rule that district heating, as a natural monopoly, should be non-profit and can therefore be consumer-owned or municipality-owned. However, rules to guarantee the ‘local signature’ of GIs can also work as a constraint. For example, the Dutch ‘zipcode rose’ net metering scheme limits the scale of collective RE projects in the Netherlands and is seen by GIs as a hindrance.

For GIs, grid access has formed a major obstacle until the liberalization of the energy market [103]. Until grid access was legally allowed, access was monopolized and GIs depended on the willingness of energy companies to grant access and purchase their electricity for a fair price. Dutch energy companies were hesitant to grant access, whereas Danish companies were more open to wind power projects because of their consumer-owned and non-profit nature. Not only access but also feed-in tariffs or priority access could be an enabling condition for GIs, as the previous section has pointed out.

Energy companies have a prominent influence on the opportunities for GIs. Large energy companies with centralized production provide a hostile environment for GIs, due to their dominance in the market and lobby strength. Sweden and the Netherlands illustrate the difficulties of GIs to engage in RE production in such a setting [104]. In contrast, Denmark shows that smaller energy companies provide a more open environment for GIs. The fact that Danish energy companies were consumer-owned is another important feature, because it allowed wind power cooperatives to be a ‘natural next step’. This illustrates another important feature of energy companies: their ownership structure. A century ago, Sweden and the Netherlands both knew a dominance of regional energy companies. In the Swedish model, production and distribution were decoupled, whereas in the Netherlands these tasks were often combined. State ownership of energy companies in Sweden proved constraining for GIs whereas municipal energy companies could serve as important partners today. Similarly, the mergers in the Netherlands led to larger and more inaccessible companies that formed a ‘cartel’, which prohibited the influence of newcomers [64]. The absence of competition and the increasingly central scale were severe constraints for GIs, which were alleviated by the liberalization. In Denmark, the liberalization had the opposite effect, as state- and consumer-owned companies with their distinctive culture were suddenly turned into ‘for profit’ companies, looking for more consolidation. As a result, electricity companies became bigger in size and fewer in number.

Next to electricity companies, businesses also influence the position of GIs. A business sector that is depending on the incumbent energy sector will not be sympathetic towards GIs and aim to maintain the equilibrium. Similarly, businesses that aggressively develop RE

projects, thereby claiming permits and land or bidding (artificially) low prices in tender procedures, reduce the opportunities for GIs to develop. Active involvement of businesses however can stimulate innovation, which can increase technological opportunities and create a political and business climate in which innovation and experimentation is encouraged. A limited acceptance of new technologies and a risk averse behavior of the government could reduce the opportunities for GIs, which can potentially act as ‘testing grounds’ for new types of projects.

The political culture determines the perceived legitimacy of GIs as voices in the political decision-making process. An open culture in which (networks of) GIs have ties with local and national political institutions, such as in Denmark, ensures a better representation of the interests of GIs than a more closed, corporatist culture with a more stable group of actors, which is difficult to access and resistant to change, such as in the Netherlands. In the latter case, the political influence of GIs remains modest and it was not until the 2013 Energy Agreement that GIs could participate in decision making. The network structures in Denmark allowed GIs such as NOAH, OVE and OOA to participate in decision making through strong networking in an open political culture. In Sweden, the political culture is dominated by the strong welfare state and the longstanding hegemony of the Social Democratic Party, which implemented sustainability programs in a top-down and bureaucratic manner [cf. 26].

4.3. The discursive dimension

The discursive dimension serves to analyze the dominant ideas and knowledge about renewable energy and the legitimacy of the activities of GIs. These ideas are held and acted upon by all actors in the sub-system, including the different government levels, market parties and citizens themselves. An overview of the important factors in the discursive dimension is shown in Table 4 below.

As each country demonstrates, the dominant discourse on energy and energy policy strongly determines which decisions the government perceives as ‘rational’. From an economic perspective, protection of the international trade position and security of supply are main concerns, which constrains radical RE policies. This can be seen in the Netherlands, where a strong dominance of the economic discourse leaves little room for non-dominant considerations of the environment and of decentralization. Conversely, in Denmark the stronger presence of the ideas of self-sufficiency and environmentalism provide an enabling condition for GIs. In Sweden, the adoption of nuclear technology led to an energy system that was both cheap and clean; a broad discourse that does however not leave much room for GIs, because nuclear power is regarded as sustainable.

Openness to alternative discourses also entails accessibility for other

Table 4
Conditions of possibility for GIs in the discursive dimension.

	Constraining conditions for GIs	Enabling conditions for GIs
Dominant discourse	Economic: affordable energy and security of supply	Sustainability: climate change mitigation and environmental protection
Openness to non-dominant discourses	Non-dominant issues such as sustainability and decentralization are not politically recognized	Non-dominant issues are acknowledged
Accessibility to political arena	Alternative discourses are not voiced in political arena or not acted upon	Alternative discourses are seen as feasible arguments. Or: complete lack of acknowledgement pushes citizens into protests
Knowledge creation and distribution	Monopoly of knowledge production of energy companies and research institutes	Democratic distribution of knowledge production
Perceived feasibility of technological innovations	Little importance attributed to alternative technologies and innovations	Positive image of innovation of technologies and collaborations between actors
Vision of energy future	Nuclear <i>Leitbild</i> , vision of centralized energy production	Open to alternative resources and scales of energy production
Culture and perspective on citizenship	Individualistic culture, 'passive' citizenship norms: state is responsible, citizens as consumers.	Cooperative tradition/culture, 'active' citizenship norms, individual is responsible, citizens as prosumers and owners of RE facilities.

discourses to the political arena: the degree to which alternative ideas are voiced in the political debate, and subsequently the degree to which they are acted upon [cf. 26]. In the Netherlands for example, following international legislation the sustainability discourse has entered the political debate, but in practice the economic inspired policies continue. In Sweden commercial hydropower and a strong centralized approach leaves little room for decentral, bottom-up solutions. In line with the general openness to non-dominant discourses, the accessibility for these discourses to the political arena is also an important condition. This can play out in two ways however. A discourse in which GIs are seen as legitimate, such as in Denmark (with the exception of the period 2002–2007) allows GIs to voice alternative ideas in the policy making process. But conversely, a complete lack of political responsiveness to public concerns, such as the anti-nuclear sentiments in the Netherlands that were met with pro-nuclear policies, can spark large protests and a DIY attitude in the community that actually inspires grassroots initiatives.

The creation and distribution of knowledge can be an important source of power in the actor constellation. Preserving a monopoly of knowledge in large incumbents and research institutes denies GIs access to a vital resource, whereas a more democratic distribution of knowledge production, which we see e.g. in Denmark, can positively influence the position of GIs by making them more professional, and NGOs have a strong influence on the research agenda and on spreading knowledge. In Sweden, the industry dictates the discourse on R & D and knowledge distribution, and in the Netherlands the research agenda is subjugated to economic principles of economic competitiveness.

GIs typically seek to be innovative, in terms of new collaborations between actors, new ways of funding, through e.g. crowdfunding, and through local experimenting with new technologies. In order to accommodate this, a positive image of technological innovations is necessary. Current Dutch legislation for example focuses on low-risk, proven technologies, thereby discouraging local and 'new' solutions. By contrast, the Danish Folkecenter and other GIs form well-known and supported testing centers for new technologies. Related to this view on innovation is the dominant vision of the future energy system. This may contain a rather conservative *Leitbild* in which the future energy system is regarded as a mix of fossil, RE and possibly nuclear power, which can be recognized in the Netherlands and Sweden. This slows down radical innovations and large investments in the RE sector. Conversely, if the energy future is imagined as a decentralized, innovative and heterogeneous combination of energy solutions, this enables GIs.

Lastly, discourses on energy are nested in a broader discourse on the role of citizens and collectivity and the prevailing perspective on citizenship. The Netherlands and (especially) Sweden share an individualistic culture in which cooperatives are a recent phenomenon. In a 'passive' understanding of citizenship, the responsibility for sustainability issues is placed with the state. This hinders collective civil responses to challenges, which in a more cooperative tradition such as Denmark would be approached through a cooperative. In Denmark, the history of cooperatives in the agricultural sector enabled the

establishment of renewable energy cooperatives such as district heating and wind power cooperatives. This displays a more 'active' understanding of citizenship, with participatory democracy and personal commitment and activism and stressing individual responsibility [26].

5. Conclusion

This paper sought to examine the conditions of possibility for GIs to develop and flourish, comparing three very different countries with different grassroots development paths. Its main question was: *what are the conditions of possibility that enable GIs to flourish, and how do GIs in turn exert influence upon these conditions?*

Turning to the first part of the question, conditional factors lie in the material-economic dimension, including the structure of the economy, the energy dependency, the potential and costs of decentral RE, and finally the energy prices compared to grey energy. These structural conditions have provided a different timing of the emergence of GIs and their impact upon the energy system. The Danish energy system changed from a fossil fuel dominated energy system in the 1980s towards a renewable energy dominated system nowadays with a relatively large role for GIs. The Dutch energy system is characterized by international trade and dependencies, is dominated by fossil fuels and lags behind in reaching RE goals. In terms of the material-economic dimension, the Swedish energy system is dominated by centralized power generation through hydropower and nuclear energy.

The actor-institutional dimension is closely connected to the material-economic dimension in terms of the presence of incumbents and accompanying market rules. The not-for profit status of many fossil energy incumbents created a possibility for strong Danish informal networks to develop RE technology after the oil crises (mainly wind) and to prove its feasibility. The dominance of these fossil-fuel incumbents and related institutions made it difficult for GIs to gain real foothold in the Netherlands, let alone emerge in Sweden. After the breaking up of monopolies and changing of market rules after the liberalization, GIs in Sweden and the Netherlands had better opportunities to produce RE, while the liberalization was constraining for GIs in Denmark because they were no longer subsidized and shielded from market mechanisms.

The discursive dimension displayed a change from economic growth towards environmental interests and security of supply. Openness for alternative discourses proved to be enabling for GI-activities, in particular when it is possible to produce legitimate knowledge that proves that RE is a true and reliable alternative, as happened in Denmark. When knowledge production is monopolized, there is hardly any room for alternative discourses, as was the case in the Netherlands and Sweden. Moreover, the Swedish discourse on passive citizenship and the welfare state leads to little perceived necessity for grassroots actions.

In terms of the second part of the research question, we conclude that GIs can exert influence upon their conditions of possibility if this is

done when a country is in search for alternative energy sources. However, GIs need a strong network with knowledge institutes, (small scale) technology developers and political parties in order to achieve institutional change that enables GIs to flourish. The Danish case illustrates the strong networking during the 1970s and 1980s, while the Dutch and Swedish cases illustrate the marginal role of GIs. In general, the last two cases show that activities of GIs are *following* institutional changes instead of forcing institutional change themselves. However, our analysis also shows that GIs can act *despite* institutions, using institutional work that enables them to adjust to institutions [cf. 105,106].

6. Discussion

Although GIs and other community energy projects have been heralded as the new hope for an alternative energy future [see for example 107], our analysis demonstrates that the impact of GIs upon the energy system remains low in energy systems with strong vested interests, such as the Netherlands and Sweden. As such, our findings correspond with the perspective that energy systems can only be transformed through the transformation of power relations and institutions [108,109][cf. 108,109]. Our findings are in line with the findings in Belgium, Germany and the UK, concerning the ‘double movement’, as Bauwens et al. demonstrate [12]: on the one hand, the environment has become more hostile for GIs, and on the other, GIs pool resources and coordinate actions to survive in this hostile environment. The contemporary power relations in Denmark, the Netherlands and Sweden remain strongly tied with the economic market discourse which dominates the actor-institutional dimension. As such, GIs have to act within a discourse that emphasizes for example ‘affordability, reliability and safety’ within a European liberalized energy market. This environment demands a commercial or businesslike attitude of GIs, in order to compete with market parties for land positions or tenders for wind projects [110].

Our paper has used a co-evolutionary institutional perspective to understand how the current energy system evolved in which GIs act. In addition to the historic developments, we now turn to the current state of GIs and what this situation implies for near-future developments of GIs.

In the Dutch case, we see that GIs are scaling up, increase co-operation with each other and professionalize. Consequently, they act more and more like private developers. This is, of course, understandable, as there is hardly any alternative outside the commercial market: the space that was created through the ‘zip code rose’ remains modest and the operating grant SDE+ that exists for large-scale RE is not economically feasible for smaller GIs, as they lack economies of scale [cf. 111]. As a result, Dutch GIs are forced to join forces and to play by the rules of the market, thereby acting more and more as developers, and less as ‘local community energy initiatives’, with the risk of losing their hallmark that ensured local support. We expect this trend to continue in the near future, as the design of RE funding in the Netherlands is unlikely to change its focus regarding projects with a large installed capacity. The challenge for GIs is to maintain their identity and support base, while scaling their projects up to fit with existing support schemes.

In Sweden, wind cooperatives, as the major share of GIs, are struggling due to low electricity prices and in some cases are not being eligible for green electricity certificates any longer as the plants are older than 15 years. It means significantly lower incomes from production, which corresponds with the fact that no wind cooperatives were initiated in recent years. In other cases the technical lifespan of many turbines is approaching, which potentially implies the end of RE production of these GIs. Regarding Swedish solar cooperatives, the trend is that professionalization is necessary in order to survive. Only a few solar cooperatives have yet succeeded in professionalizing, aided

by the close connections they maintain with municipal energy companies. Others planned to start a more professional approach but have not (yet) achieved this. In the near future, as the bar is raised for both wind and solar cooperatives, it will be difficult for this group to achieve the necessary level of professionalism with the modest resources they have at their disposal.

In Denmark, the same tendencies are visible when compared to the Dutch situation, with the difference that to some extent ‘acting professionally’ in the past meant ‘being the first one to make a business out of renewable energy’. The result was that many former grassroots members later on had become consultants and developers. Thus, professionalization was to some extent a result of grassroots activity and to some extent initiated by it – instead of being a constraining factor for GI activities. Furthermore, today, most developers play according to the rules of the market and mainly try to maximize their profits from RE projects, with the exception of some innovative GIs, such as Wind People [110], which specifically have local development and local ownership in their business model. However, the current tendency to ‘professionalize’ and upscale on e.g. the onshore wind power market is also being counteracted by municipalities and local citizens who start to protest against and block large wind farms (e.g. Esbjerg and Tønder municipalities in Southern Denmark against Vattenfall). Therefore, on the one hand, tensions between large wind power projects and local communities are intensifying, and on the other, the space for GIs is being taken over by private actors. As a consequence, it can be speculated that the onshore wind power market and possibly other RE markets will see a complete collapse, or, space for GIs to more successfully develop failed RE projects might be created again. As this article has argued, the latter will only happen on the basis of an adequate political framework.

These recent developments show that GIs rely on institutional support by governments or incumbents. Without institutional space, they remain subjected to the dominant power-relations, and cannot exert much influence upon the energy system [109]. When these power-relations remain unaltered, and institutional space is given for development of RE, GIs become instrumental in creating and enhancing community support for RE. The local and voluntary nature of GIs limits their capacity for professionalization and scaling up in order to meet the criteria for funding and market competition, and this will only be attainable for a few. Thus, participation in the energy system will be restricted towards legitimizing RE power production, developed by incumbents within the ‘hard energy path’ [cf. 112] with large offshore wind parks or biomass co-combustion [18]. In that case, grassroots activities will lead to path improvement rather than path change.

Funding information

This research has received funding from The Netherlands Organisation for Scientific Research (NWO), the Danish Council for Strategic Research and the Swedish Research Council Formas as part of the JPI Climate Joint Call for Transnational Collaborative Research Projects, Societal Transformation in the Face of Climate Change and as part of the project Ethics and Energy, funded by the Danish Research Council for the Humanities.

Acknowledgements

We would like to thank Arnoud Legendijk and Mark Wiering and the anonymous reviewers for their valuable comments and suggestions to improve the quality of the paper. In addition, we would like to thank all the respondents for their cooperation and valuable input and time for this study.

Appendix A. Key respondents per country

Sweden

1. Martensson, Kenneth. Solel i Sala och Heby ekonomisk förening & Sala-Heby Energi solar cooperative, Sala.
2. Andersson, Sven-Allan. Kvarkenvinden wind cooperative, Umeå.
3. Forsmark, Jan. Hela Sverige ska leva Interest organization for rural development, Sala.
4. Thiel, Pella. Omställning Sverige Transition movement interest organization, Uppsala.
5. Yones, Stina. OX2 Vind & Solivind El Ekonomisk förening wind cooperative, Stockholm.
6. Hägerström, Lars. Solel i Näversjön solar cooperative, Näversjön.
7. Larsson, Staffan. Kalmarsund & Kalmar Energi solar cooperative, Kalmar.
8. Nyholm, Charlotta. Solbyn Eco-village, Dalby.
9. Karlsson, Lars-Erik. Södra Ljunga bioenergy and heating, Ljungby.
10. Lundsten, Lars. Barsbro kraftaktiebolag hydro power plant, Rottne.

Denmark

11. Elling Scheele, Christian. CIDEA Citizen Driven Environmental Action, Copenhagen.
12. Flagstad, Frederik. GreenGo Energy, Copenhagen.
13. Rasmussen, Lotte. NEAS Energy Trading, Aalborg.
14. Livijn, Kriestian. Dong Energy, Skaerbark Fredericia.
15. Kristensen, Anders. Danish Energy Agency and Ministry of Energy, Copenhagen.
16. Rask Nielsen, Poul. EnergiByen Frederikshavn municipality and Energy City, Frederikshavn.
17. Langbak Hansen, Louise. Region Midtjylland, Viborg.
18. Vangstrup, Lea. Wind People NGO and Aero wind grassroots initiative, Skørping.
19. Madsen, Svenning. Aarhus Bugt near shore wind community initiative, Aarhus.
20. Christensen, Peter. Samsø Energy Academy, Samsø.
21. Brodersen, Hans Jørgen. DanWEC Danish Wave Energy Centre, Hanstholm.
22. Krogsgager, Mette. Folkecenter research and development facility, Ydby.

The Netherlands

23. Zomer, Siward. ODE Decentraal umbrella organization for renewable energy cooperatives, Utrecht.
24. Prins, Katrien. HIER Opgewekt platform for grassroots initiatives for renewable energy, Utrecht.
25. Olthuis, Felix. DE Unie, umbrella organization for renewable energy producing initiatives, and Kennemerwind wind cooperative, Utrecht.
26. De Ridder, Pim. Windpark Nijmegen wind cooperative, Nijmegen.
27. Van Nistelrooij, Bas. Noviovolta community initiative for solar power, Nijmegen.
28. De Meijer, Alex. Gelderse Natuur- en Milieufederatie, provincial umbrella for local and regional environmental associations, Arnhem.
29. Boot, Pieter. PBL Netherlands Environmental Assessment Agency, Bilthoven.
30. Van der Leij, Ernst. Morgen Groene Energie community solar cooperative, Nuenen.
31. Bekhuis, Jan. Province of Gelderland, Arnhem.
32. Sommerdijk, Felix. Zonnepark Nederland, Installer collective PV solar parks, Nijmegen.

33. De la Court, Thijs. Gelders Energie Akkoord, energy agreement Province of Gelderland, Lochem.

34. Stevens, Ruud. Energiefonds Overijssel, regional energy fund Province of Overijssel, Zwolle.

References

- [1] EPC, E.P.a.C. (EPC) (Ed.), Directive 2009/28/EC, Official Journal of the European Union, Brussels, 2009.
- [2] EC, Renewable Energy Progress Report, European Commission (EC), Brussels, 2013.
- [3] S.O. Negro, F. Alkemade, M.P. Hekkert, Why does renewable energy diffuse so slowly? A review of innovation system problems, *Renew. Sustain. Energy Rev.* 16 (6) (2012) 3836–3846.
- [4] G. Seyfang, A. Smith, Grassroots innovations for sustainable development: towards a new research and policy agenda, *Environ. Pol.* 16 (4) (2007) 584–603.
- [5] F. Hvelplund, Innovative democracy and renewable energy strategies: a full-scale experiment in Denmark 1976–2010, in: M. Järvälä, S. Juhola (Eds.), *Energy, Policy, and the Environment*, Springer, New York & Dordrecht, 2011, pp. 89–113.
- [6] M. Ornetzeder, H. Rohracher, Of solar collectors, wind power, and car sharing: comparing and understanding successful cases of grassroots innovations, *Global Environ. Change* 23 (5) (2013) 856–867.
- [7] A. Smith, et al., Making the most of community energies: three perspectives on grassroots innovation, *Environ. Plann. A* 48 (2) (2015) 407–432.
- [8] J.A.M. Hufen, J.F.M. Koppenjan, Local renewable energy cooperatives: revolution in disguise? *Energy Sustain. Soc.* 5 (1) (2015) 1–14.
- [9] T. Hoppe, et al., Local governments supporting local energy initiatives: lessons from the best practices of Serbeck (Germany) and Lochem (The Netherlands), *Sustainability* 7 (2) (2015) 1900–1931.
- [10] T. van der Schoor, B. Scholtens, Power to the people: local community initiatives and the transition to sustainable energy, *Renew. Sustain. Energy Rev.* 43 (0) (2015) 666–675.
- [11] G. Seyfang, et al., A grassroots sustainable energy niche? Reflections on community energy in the UK, *Environ. Innov. Soc. Transit.* 13 (0) (2014) 21–44.
- [12] T. Bauwens, B. Gotchev, L. Holstenkamp, What drives the development of community energy in Europe? The case of wind power cooperatives, *Energy Res. Soc. Sci.* 13 (2016) 136–147.
- [13] S.C. Klain, et al., Will communities open-up to offshore wind? Lessons learned from New England islands in the United States, *Energy Res. Soc. Sci.* 34 (2017) 13–26.
- [14] J. Schot, F.W. Geels, Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy, *Technol. Anal. Strateg. Manage.* 20 (5) (2008) 537–554.
- [15] A. Smith, R. Raven, What is protective space? Reconsidering niches in transitions to sustainability, *Res. Policy* 41 (6) (2012) 1025–1036.
- [16] T. Hargreaves, et al., Grassroots innovations in community energy: the role of intermediaries in niche development, *Global Environ. Change* 23 (5) (2013) 868–880.
- [17] N. Magnani, G. Osti, Does civil society matter? Challenges and strategies of grassroots initiatives in Italy's energy transition, *Energy Res. Soc. Sci.* 13 (2016) 148–157.
- [18] M. Oteman, H.-J. Kooij, M. Wiering, Pioneering renewable energy in an economic energy policy system: the history and development of Dutch grassroots initiatives, *Sustainability* 9 (4) (2017) 550.
- [19] F.W. Geels, The multi-level perspective on sustainability transitions: responses to seven criticisms, *Environ. Innov. Soc. Transit.* 1 (1) (2011) 24–40.
- [20] F. Kern, A. Smith, Restructuring energy systems for sustainability? Energy transition policy in the Netherlands, *Energy Policy* 36 (11) (2008) 4093–4103.
- [21] C.A. Miller, J. Richter, J. O'Leary, Socio-energy systems design: a policy framework for energy transitions, *Energy Res. Soc. Sci.* 6 (2015) 29–40.
- [22] H. Lund, Choice awareness: the development of technological and institutional choice in the public debate of Danish energy planning, *J. Environ. Policy Plann.* 2 (3) (2000) 249–259.
- [23] H. Lund, The implementation of renewable energy systems: lessons learned from the Danish case, *Energy* 35 (10) (2010) 4003–4009.
- [24] M. Mendonça, S. Lacey, F. Hvelplund, Stability, participation and transparency in renewable energy policy: lessons from Denmark and the United States, *Policy Soc.* 27 (4) (2009) 379–398.
- [25] K. Sperling, F. Hvelplund, B.V. Mathiesen, Evaluation of wind power planning in Denmark – towards an integrated perspective, *Energy* 35 (12) (2010) 5443–5454.
- [26] A. Jamison, et al., *The Making of the New Environmental Consciousness: A Comparative Study of Environmental Movements in Sweden, Denmark and the Netherlands Vol. 1* Edinburgh University Press, Edinburgh, 1990.
- [27] T.J. Foxon, A coevolutionary framework for analysing a transition to a sustainable low carbon economy, *Ecol. Econ.* 70 (12) (2011) 2258–2267.
- [28] K.A.M. Van Assche, R. Beunen, M. Duineveld, *Evolutionary governance theory. An introduction*, Springer Briefs in Economics, Springer International Publishing, New York, 2014.
- [29] M. Oteman, M. Wiering, J.-K. Helderman, The institutional space of community initiatives for renewable energy: a comparative case study of the Netherlands, Germany and Denmark, *Energy Sustain. Soc.* 4 (1) (2014) 11.
- [30] P. Andrews-Speed, Applying institutional theory to the low-carbon energy transition, *Energy Res. Soc. Sci.* 13 (2016) 216–225.
- [31] R. Beunen, K. Van Assche, M. Duineveld, *Evolutionary Governance Theory: Theory and Applications*, Springer International Publishing, Dordrecht, 2015.
- [32] S. Wirth, Communities matter: institutional preconditions for community renewable energy, *Energy Policy* 70 (2014) 236–246.
- [33] D.C. North, J. Alt, D.C. North (Eds.), *Institutions, Institutional Change and*

- Economic Performance Political Economy of Institutions and Decisions, Cambridge University Press, New York, 1990.
- [34] D.C. North, Understanding the Process of Economic Change, Princeton University Press, Princeton, New Jersey, 2005.
- [35] S. Becker, M. Naumann, Energy democracy: mapping the debate on energy alternatives, *Geogr. Compass* 11 (8) (2017) e12321-n/a.
- [36] H.J. Kooij, Object formation and subject formation: the innovation campus in the Netherlands, *Plann. Theory* 14 (4) (2015) 339–359.
- [37] S. Wirth, et al., Informal institutions matter: professional culture and the development of biogas technology, *Environ. Innov. Soc. Transit.* 8 (2013) 20–41.
- [38] International Energy Agency, Statistics by Country, (2017) Available from: <http://www.iea.org/statistics/statisticssearch/>.
- [39] Danish Energy Agency, Danish Energy Statistics, (2016) Copenhagen.
- [40] Danish Energy Agency, Oil and Gas Production in Denmark 2014, (2015) Copenhagen.
- [41] Dansk Fjernvarme, Dansk Fjernvarme – Statistik 2016. Halvdelen Af Fjernvarmen Er Nu CO₂-neutral, (2017) (Kolding).
- [42] Danish Energy Agency, Master Data Register of Wind Turbines, (2017) Copenhagen.
- [43] Energitilsynet, Energitilsynets Fjernvarmestatistik December 2016, (2016) Valby).
- [44] B. Brøndum, M. Mackie, K. Elkjær Nielsen, 60 år i tal – Danmark siden 2. verdenskrig, Danmarks Statistik, 2008, 2017.
- [45] Johnsen Nielsen, Å. Et udviklingsforløb, E. Beuse et al. (Eds.) 2000, Organisationen for Vedvarende Energi: Århus.
- [46] E. Beuse, et al., E. Beuse (Ed.), Græsrods-ursumpen, in Vedvarende energi i Danmark - En kronike om 25 opvekstår 1975–2000, Organisationen for Vedvarende Energi, Århus, 2000.
- [47] E. Beuse, et al., E. Beuse (Ed.), Energikontorerne organiserer sig, in Vedvarende energi i Danmark - En kronike om 25 opvekstår 1975–2000, Organisationen for Vedvarende Energi, Århus, 2000.
- [48] S. Blegaa, et al., Sketch of an Alternative Energy Plan for Denmark, (1976) Copenhagen.
- [49] S. Blegaa, et al., Alternative Danish energy planning, *Energy Policy* 5 (2) (1977) 87–94.
- [50] F. Hvelplund, Innovative democracy, political economy, and the transition to renewable energy. A full-scale experiment in Denmark 1976–2013. *environmental research, Eng. Manage.* 66 (4) (2013) 5–21.
- [51] N.I. Meyer, Anden Alternative Energiplan 1983, Organisationen for Vedvarende Energi, Århus, 2000.
- [52] Elmuseet, et al., Kapitler af Vindkraftens Historie, 6th ed., Elmuseet; Poul la Cour Museet; Nordisk Folkecenter for Vedvarende Energi; Danmarks Vindkraftshistoriske Samling, Bjerringbro, 2010.
- [53] U. Geertsen, Vindkræfteventyret – og de globale kriser, *Klim, Århus*, 2009, p. 286.
- [54] N.I. Meyer, et al., E. Beuse (Ed.), Provestationer for VE og information om VE, Organisationen for Vedvarende Energi, Århus, 2000.
- [55] N.I. Meyer, Renewable energy policy in Denmark, *Energy Sustain. Dev.* 8 (1) (2004) 25–35.
- [56] M. Bolinger, Community Wind Power Ownership Schemes in Europe and Their Relevance to the United States, (2001) Berkeley.
- [57] N. Fuglsang, Fra oliekrise til grøn vækst, (2011).
- [58] Danish Ministry of the Environment, Executive Order Regarding the Amendment of the Executive Order Regarding the Connection of Wind Turbines to the Grid (Bekendtgørelse Om ændring Af Bekendtgørelse Om Vindmøllers Tilslut- Ning Til Elnettet), Danish Ministry of the Environment, Copenhagen, 2000.
- [59] Energi- Forsynings- og Klimaministeriet, Bekendtgørelse af lov om fremme af vedvarende energi, Copenhagen, Energi-, Forsynings- og Klimaministeriet, 2016.
- [60] A. Chittum, P.A. Østergaard, How Danish communal heat planning empowers municipalities and benefits individual consumers, *Energy Policy* 74 (C) (2014) 465–474.
- [61] OECD, OECD Environmental Performance Reviews. The Netherlands 2015, OECD Publishing, Paris, 2015.
- [62] A.M. Schwencke, Lokale energiemonitor 2015. Burgers partciperen in energie Resultaten en impact van de burgerenergiebeweging, HIER opgewekt, Utrecht, 2015.
- [63] CBS, De invloed van de aardgaswinning op de Nederlandse economie, Centraal Bureau voor de Statistiek, Den Haag, 2015.
- [64] G. Verbong, F. Geels, The ongoing energy transition: lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960–2004), *Energy Policy* 35 (2) (2007) 1025–1037.
- [65] Rijksoverheid, Miljoenennota 2016. Nota over de toestand van 's Rijks financiën, Ministry of Finance, The Hague, 2015.
- [66] Tweede Kamer der Staten-Generaal, First White Paper on Energy (Eerste Energieneota), Tweede kamer, The Hague, 1974 zitting 1974–1975, 13122 ms. 1–2.
- [67] A. van Hal, Beyond the Backyard: Sustainable Housing Experiences in Their National Context, Uitgeverij Aeneas, Best, 2000, p. 73.
- [68] S. Agterbosch, Empowering Wind Power; on Social and Institutional Conditions Affecting the Performance of Entrepreneurs in the Wind Power Supply Market in the Netherlands, Utrecht University, Utrecht, 2006.
- [69] F.A. Van der Loo, Op weg naar het zuiden, Maurits Groen Milieumcommunicatie, Haarlem, 2012.
- [70] G. Verbong, et al., Een kwestie van lange adem: de geschiedenis van duurzame energie in Nederland, Aeneas, Bostel, 2001, p. 423.
- [71] SER, Energieakkoord voor duurzame groei, Sociaal-Economische Raad, Den Haag, 2013.
- [72] EZ, Energieagenda Naar een CO₂-arme energievoorziening, Ministerie van Economische Zaken, Den Haag, 2016.
- [73] J. Hult, Svenskt teknikhistoria, Gidlund, Hedemora, 1989.
- [74] A. Kaijser, A. Mogren, P. Steen, Att ändra riktning: villkor för ny energiteknik, Allmänna förlaget, Stockholm, 1988.
- [75] M. Bladh, En elektrisk historia: elsystemets och elanvändningens utveckling i Sverige, Linköpings universitet, Linköpings, 2002.
- [76] L.J. Lundgren, Energipolitik i Sverige 1890–1975: Sammanfattning av studie utarbetad på uppdrag av framtidsstudien Energi och Samhälle, Projektgruppen Energi och samhälle, Sekretariatet för framtidsstudier, Stockholm, 1978.
- [77] P. Högselius, A. Kaijser, När folkhemselen blev internationell: Elavreglingen i historiskt perspektiv, Stockholm, SNS förlag, 2007.
- [78] J. Palm, V. Marcou, L'Administration communale du système de l'énergie en Suède-une perspective historique et les développements actuels, in: G. Marcou, H. Wollmann (Eds.), *Annuaire 2007 des collectivités locales*, CNRS Éditions, Paris, 2007, pp. 145–160.
- [79] L. Baas, D. Magnusson, S. Mejía-Dugand, Emerging Selective Enlightened Self-Interest Trends in Society: Consequences for Demand and Supply of Renewable Energy, Linköping University Electronic Press, 2014.
- [80] D. Magnusson, J. Palm, Come together – historic development of Swedish Energy Communities. *Environmental Innovation and Societal Transitions* (submitted).
- [81] J. Anshelm, Mellan frälsning och domedag: om kärnkraftens politiska idéhistoria i Sverige 1945–1999, Symposium, 2000.
- [82] A.-S. Kall, Föryntelse med förhinder: Den riksdagspolitiska debatten om omställningen av energisystemet 1980–2010, Linköping University Electronic Press, 2011.
- [83] J. Palm, Maktens över energin: policyprocesser i två kommuner 1977–2001, Linköping University Electronic Press, Linköping, 2004.
- [84] D. Magnusson, Who brings the heat? – From municipal to diversified ownership in the Swedish district heating market post-liberalization, *Energy Res. Soc. Sci.* 22 (2016) 198–209.
- [85] T. Wizelius, Vindkraft tillsammans: handbok för vindkooperativ, Vindform förlag, Stockholm, 2012.
- [86] Naturvårdsverket, Klimatinvesteringsprogrammen Klimp 2003–2012 Slutrapport. Rapport 6517, Naturvårdsverket, Stockholm, 2013.
- [87] Swedish Energy Agency, Om elcertifikatsystemet, (2017) 7 July 2017; Available from: <http://www.energimyndigheten.se/fornybart/elcertifikatsystemet/om-elcertifikatsystemet/>.
- [88] J. Palm, Development of sustainable energy systems in Swedish municipalities: a matter of path dependency and power relations, *Local Environ.* 11 (4) (2006) 445–457.
- [89] J. Palm, M. Tengvard, Motives for and barriers to household adoption of small-scale production of electricity: examples from Sweden, *Sustain.: Sci. Pract. Policy* 7 (1) (2011) 6–15.
- [90] Swedish Energy Agency, Energiläget 2015, Energimyndigheten, Eskilstuna, 2015.
- [91] Swedish Energy Agency, Energiläget 2016, Energimyndigheten, Eskilstuna, 2016.
- [92] L. Magnusson, An Economic History of Sweden Vol. 16 Routledge, London, 2000.
- [93] J.L. Van Zanden, The Economic History of the Netherlands 1914–1995: A Small Open Economy in the 'Long' Twentieth Century Vol. 1 Routledge, London, 2005.
- [94] I. Henriksen, An Economic History of Denmark, EH. Net Encyclopedia, 2006 (October).
- [95] J. Notenboom, P. Boot, An Essay on the Colourful Scene of Europe's Energy Transition, PBL, den Haag, 2016.
- [96] K.C. Seto, et al., Carbon lock-in: types, causes, and policy implications, *Annu. Rev. Environ. Resour.* 41 (2016) 425–452.
- [97] B. Lehner, G. Czisch, S. Vassolo, Europe's Hydropower Potential Today and in the Future, EuroWasser: Model-based Assessment of European Water Resources and Hydrology in the Face of Global Change, Kassel, 2001 (Chapter 8).
- [98] European Environment Agency, Europe's Onshore and Offshore Wind Energy Potential. An Assessment of Environmental and Economic Constraints, European Environment Agency, Copenhagen, 2009.
- [99] Institute for Energy and Transport, Solar Radiation and Photovoltaic Electricity Potential Country and Regional Maps for Europe, (2017) (11 April 2017, Available from:), <http://re.jrc.ec.europa.eu/pvgis/cmeps/eur.htm>.
- [100] B. Södersten, Globalization and the Welfare State, Palgrave Macmillan, Basingstoke and New York, 2004.
- [101] F. Hvelplund, B. Möller, K. Sperling, Local ownership: smart energy systems and better wind power economy, *Energy Strategy Rev.* 1 (3) (2013) 164–170.
- [102] K. Sperling, How does a pioneer community energy project succeed in practice? The case of the Samsø Renewable Energy Island, *Renew. Sustain. Energy Rev.* 71 (2017) 884–897.
- [103] J. Lipp, Lessons for effective renewable electricity policy from Denmark, Germany and the United Kingdom, *Energy Policy* 35 (11) (2007) 5481–5495.
- [104] S. Agterbosch, The wind-power market in the Netherlands, in: P.A. Strachan, D. Lal, D. Toke (Eds.), *Wind Power and Power Politics: International Perspectives*, Routledge, New York & London, 2009, pp. 59–85.
- [105] T.B. Lawrence, R. Suddaby, et al., institutions and institutional work, in: S.R. Clegg (Ed.), *The Sage Handbook of Organization Studies*, Sage, London, 2006, pp. 215–254.
- [106] R. Beunen, J.J. Patterson, Analysing institutional change in environmental governance: exploring the concept of 'institutional work', *J. Environ. Plann. Manage.* (2017) 1–18.
- [107] J. Rotmans, In het oog van de orkaan: Nederland in transitie, Aeneas, Bostel, 2012, p. 270.
- [108] L. Gailing, Transforming energy systems by transforming power relations. Insights from dispositive thinking and governmentality studies, *Innov.: Eur. J. Soc. Sci. Res.* 29 (3) (2016) 243–261.
- [109] M. Markantoni, Low carbon governance: mobilizing community energy through top-down support? *Environ. Policy Gov.* 26 (3) (2016) 155–169.
- [110] L.K. Jensen, K. Sperling, Who Should Own the Nearshore Wind Turbines?: A Case Study of the Wind & Welfare Project, Aalborg University, Department of Development and Planning, Aalborg, 2016.
- [111] A.L. Berka, et al., A comparative analysis of the costs of onshore wind energy: is there a case for community-specific policy support? *Energy Policy* 106 (2017) 394–403.
- [112] P.A. Strachan, et al., Promoting community renewable energy in a corporate energy world, *Sustainable Development* 23 (2) (2015) 96–109.